

2006

Microwaves & RF

EDITORIAL INDEX

COMMERCIAL

- The big picture (*March*, p. 42)
- Here's how we solved it (*July*, p. 27)
- Charting the course for 45 years of Microwaves (*August*, p. 33)
- Special Section: Microwave Legends (*August*, p. 51)
- Top products of 2006 (*December*, p. 90)

COMMUNICATIONS

- Making the most of millimeter waves (*October*, p. 40)

COMPONENTS

- Amplifying PA theory for efficient ISM transmitters (*January*, p. 51)
- Darlington gain blocks eliminate bias resistor (*January*, p. 70)
- SiGe silences YIG oscillator phase noise (*January Cover*, p. 79)
- Low-noise amplifiers drop below 1-dB noise-figure mark (*January White Paper*)
- Modules house multitudes of functions (*February*, p. 33)
- Microwave connector choices determine system performance (*March*, p. 78)
- Analyzing EM parameters for shielded bandline (*March*, p. 86)
- Stabilize transistors in low-noise amplifiers (*May*, p. 81)

- Emerging applications fuel antenna development (*May*, p. 134)
- FBAR duplexers help shrink PCS/UMTS handsets (*May*, p. 140)
- S-band power amp incorporates bare die (*June*, p. 57)
- LTCC launches miniature, wideband, low-cost mixers (*June Cover*, p. 107)
- Wide-range trimmers fit into chip housings (*June*, p. 116)
- Plethora of patents fuels licensing foray (*July*, p. 46)
- Topology and technology drive E-PHEMT amplifiers (*July*, p. 78)
- Surface-mount amps span 0.1 to 40.0 GHz (*July Cover*, p. 88)
- Understanding mismatch effects in power combining circuits (*August*, p. 79)
- Upconverter mixer makes most of LTCC for ISM applications (*August*, p. 104)
- "Invisible" wireless antenna offers in-building coverage (*August*, p. 134)
- Directional couplers aid antenna power monitoring (*September*, p. 78)
- Monopole arrays are electronically steerable (*September*, p. 88)
- Passive components stay on path of re-invention (*October*, p. 33)
- Practical approach yields class C PA (*October*, p. 55)
- Simplify the calculation of microstrip

dimensions (*October*, p. 66)

- Design directional couplers for high-power applications (*October*, p. 90)
- Shrinking cables and connectors raise performance (*November*, p. 33)
- RF video amplifiers enable FTTP's last mile (*November*, p. 59)
- Site speeds search for RF/microwave components (*November Cover*, p. 107)
- Design a simple, low-cost UWB source (*December*, p. 68)

COMPUTER-AIDED ENGINEERING

- Verification tools help PHS transceiver take silicon form (*February*, p. 57)
- Simulation spices RFID read rates (*March*, p. 66)
- Software library speeds mobile WiMAX designs (*March*, p. 102)
- EM software suite models IC coupling (*March*, p. 103)
- Simulation tools build on electromagnetic analysis (*June*, p. 112)
- Parametric simulation helps optimize antenna performance (*November*, p. 78)
- Software shortens path to working RF designs (*November*, p. 120)

CONFERENCES

- Microwave show comes to the City

by the Bay (May, p. 33)

CROSSTALK

- An interview with RF Micro Devices' Jerry D. Neal (February, p. 38)
- An Interview with Gavin Woods, Freescale Semiconductor's RF Division (June, p. 42)
- An interview with Digital Fountain's Charlie Oppenheimer (July, p. 42)
- An interview with Microphase Corp.'s Necdet "Ned" Ergul (August, p. 65)

DEFENSE ELECTRONICS

- Generate digital chirp signals with DDS (February, p. 72)
- Technology secures borders and shores up com links (June, p. 33)

DEVICES & ICs

- Enhanced UltraCMOS yields GSM/WCDMA switches (January,

p. 84)

- Differential amp buffers ADCs to 2 GHz (January, p. 87)
- Software defines cellular transceiver IC (February Cover, p. 90)
- Single chip houses analog/digital TV receiver (March Cover, p. 97)
- Diode quad is foundation for PIN diode attenuator (May, p. 61)
- RF antenna switches simplify telematics radios (May, p. 108)
- SiGe T/H amplifier grabs wideband data (May Cover, p. 127)
- Rugged LDMOS device drives 500 W At 500 MHz (May, p. 142)
- Chip supports dynamic point-to-point systems (May, p. 144)
- MEMS motion sensors boost handset reliability (June, p. 84)
- RF MEMS integrates CMOS controller (June, p. 96)
- High-power transistors surf GaN wave (July, p. 33)

- Developing designs for RFID transponders (September, p. 57)
- GaN transistors reach for high power and linearity (September, p. 112)
- Traffic management performs testing for triple-play services (October, p. 70)
- 2006 IEDM points way for device power and speed (November, p. 40)
- Design an MMIC LNA with GaAs PHEMTs (November, p. 68)
- Low-cost IC simplifies software GPS receivers (December Cover, p. 80)
- GaN FET generates 81.3 W at 9.5 GHz (December, p. 96)

SYSTEMS & SUBSYSTEMS

- Estimating RKE system performance (February, p. 82)
- Frequency synthesizers tune communications systems (March, p. 33)
- Filtering compromises from co-located systems (March, p. 57)
- Low-power approach provides QPSK modulation (May, p. 91)
- When switching speed is important (May, p. 98)
- Signal cancellation improves DDS SFDR (August Cover, p. 120)
- Optical switches link multiple receivers to remote antennas (August, p. 112)
- Frequency synthesizers supply stable signals (September, p. 33)
- Technology cancels cellular interference (September, p. 44)
- Develop advanced designs for RFID transponders (October, p. 82)
- Spread-spectrum modules communicate at 2.4 GHz (October, p. 110)
- ACM controls cost of increased spectral efficiency (November, p. 92)
- Chilean antenna array reaches deep across space (December, p. 33)

TEST & MEASUREMENT

- Tracking trends in test equipment (January, p. 33)
- Test handset PA phase and amplitude vs. time (January, p. 51)
- Scopes pack big power into small footprints (January, p. 88)
- Peak power meters offer 65-MHz

**Microwaves
& RF**

presents a new webcast series sponsored by

Agilent Technologies

Webcast Exploring Design and Test Challenges in the Wireless World

This series of six webcasts delves into the nitty gritty of designing wireless products for WiMax, Ultrawideband, WiFi, ZigBee and Bluetooth wireless systems and concludes with a special webcast that looks at how to approach testing in all of these areas. Each webcast will include an overview of the technology from industry experts as well as a close look at some of the challenges and solutions when designing with these technologies. In addition, the webcast will cover some of the latest products in these areas, along with a discussion of some of the pros and cons of designing with each product.

The first webcast - Designing for WiMax - will be on February 22, 2007.

Go to www.mwrf.com/dfw to register today!

bandwidth (*March, p. 104*)

- Extending phase-noise measurement capability (*May, p. 70*)
- Measure frequency with time-stamping counters (*May, p. 115*)
- Properly understanding noise in test applications (*June, p. 70*)
- Vector signal generator spans 0.4 to 2.5 GHz (*June, p. 115*)
- Establish test procedures for WiMAX transceivers (*July, p. 63*)
- System monitors satellite carriers (*July, p. 94*)
- Building a receiver for WiMAX testing (*August, p. 92*)
- Economy spectrum analyzer spans

100 kHz to 7.1 GHz (*August, p. 130*)

- Spectrum analyzer doubles as phase-noise test set (*August, p. 132*)
- Next-generation instruments speed wireless testing (*September Cover, p. 99*)
- Understand requirements for WiMAX testing (*September, p. 70*)
- Handheld analyzer scans 4-GHz spectrum (*September, p. 110*)
- Tiny instruments combine power meter and sensor (*September, p. 114*)
- Signal generator melds speed with low phase noise (*October Cover, p. 103*)
- Real-time analyzer captures elusive

RF signals (*October, p. 112*)

- Improve the accuracy of amplifier ACLR and ACPR measurements (*October White Paper*)
- Power sensors work with USB computers (*November, p. 116*)
- Vector signal generator cuts measurement costs (*November, p. 118*)
- Small-footprint oscilloscopes reach 2 GHz (*November, p. 122*)
- Measure and troubleshoot digitally modulated signals (*November White Paper*)
- Beware of spectrum analyzer power averaging techniques (*December, p. 57*)

VNA ACCURACY, PART 1

■ Design Feature

Table 3: Summary uncertainties (95% confidence level) for reflection measurements

MEASURED MAGNITUDE VRC (LINEAR UNITS)	UNCERTAINTY IN MAGNITUDE VRC (LINEAR UNITS)
0	± 0.0057
1	± 0.020

(continued from page 68)

ticular, it has shown that by using characterized calibration standards very good measurement accuracy is obtained without the need to use precision components. This is achieved by using measurement-derived data during the calibration of the VNA. Measurement intercomparisons between the LA19-13-02 VNA and NPL have shown very good agreement (i.e., the uncertainties for the LA19-13-02 measurements encompass the values obtained by NPL). This shows that the uncertainties established for the LA19-13-02 are realistic.

The overall uncertainty in reflection measurements varies depending on the size of the measured reflection. This is summarized in **Table 3**, which gives values at the extremes of the measurement range, i.e., at magnitude VRC equal to zero and one.

The overall uncertainty in attenua-

tion measurements also varies with the size of the measured attenuation. This is summarized in **Table 4** for selected values of attenuation to 60 dB. Beyond 60 dB, the error due to isolation/crosstalk in the VNA dominates the overall measurement uncertainty.

The summary of VNA measurement uncertainties presented here provides a performance specification for the accuracy of the LA19-13-02 VNA that has been independently verified by a national measurement standards laboratory (NPL). It is considered that the demonstrated accuracy compares favourably with VNAs made by the other leading manufacturers of these instruments. **MRi**

ACKNOWLEDGMENT

The work described here was partially funded by the UK government. Specifically, the Measurement for Innovators Programme of the National Measurement System Directorate, Department of Trade and Industry. © Crown

Table 4: Summary uncertainties (95% confidence level) for attenuation measurements

MEASURED ATTENUATION (dB)	UNCERTAINTY IN ATTENUATION (dB)
0	± 0.021
20	± 0.046
40	± 0.054
60	± 0.70

Copyright 2007. Reproduced by permission of the Controller of HMSO.

REFERENCES

1. Nick Ridler and Nils Nazoa, "Using simple calibration load models to improve accuracy of vector network analyzer measurements," *67th ARFTG Conference Digest*, pp. 104-110, San Francisco, CA, June 2006.
2. Nils Nazoa and Nick Ridler, "LA19-13-01 3 GHz VNA calibration and measurement uncertainty," *LA Techniques Ltd, Technical Note Ref LAP02*, January 2006. Available from www.latechniques.com.
3. M.J. Salter and N.M. Ridler, "Measuring the capacitance coefficients of coaxial open-circuits with traceability to national standards," *Microwave Journal*, Vol. 49, No. 10, October 2006, pp. 138-154.
4. "EA guidelines on the evaluation of Vector Network Analysers (VNA)," European co-operation for Accreditation, publication reference EA-10/12, May 2000.
5. "Expression of the uncertainty of measurement in calibration," European co-operation for Accreditation, publication reference EA-4/02, December 1999.
6. ISO/IEC 17025:2005, "General requirements for the competence of testing and calibration laboratories."
7. Nils Nazoa and Nick Ridler, "LA19-13-02 3 GHz VNA calibration and measurement uncertainty," *LA Techniques Ltd, Technical Note Ref LAP03* (to be published). Available from www.latechniques.com.
8. N.M. Ridler, "Converting between logarithmic and linear formats for reflection and transmission coefficients," *ANAMET Technical Note*, No. 4, October 2000. Available from www.npl.co.uk/anamet.
9. N.M. Ridler and J.C. Medley, "An uncertainty budget for VHF and UHF reflectometers," *NPL Report DES 120*, May 1992. Available from www.npl.co.uk.